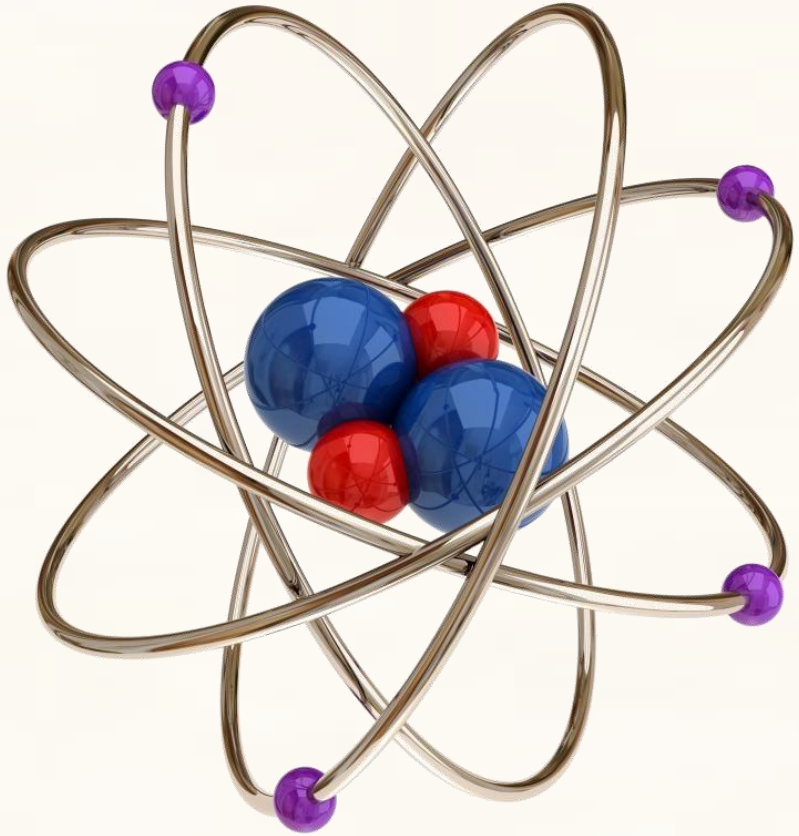


Cold Source Engineering:

Operation and Upgrade of the BT-9 Cold Source, Nicknamed “PeeWee”

James Torres

B.S. Physics, Rowan University

Mentor: Michael Middleton

Director: Julie Borchers

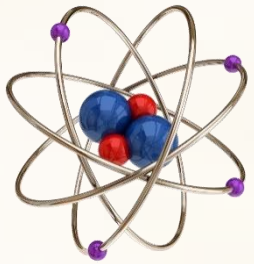
NIST

CHRNS CENTER FOR HIGH RESOLUTION NEUTRON SCATTERING NSF NIST

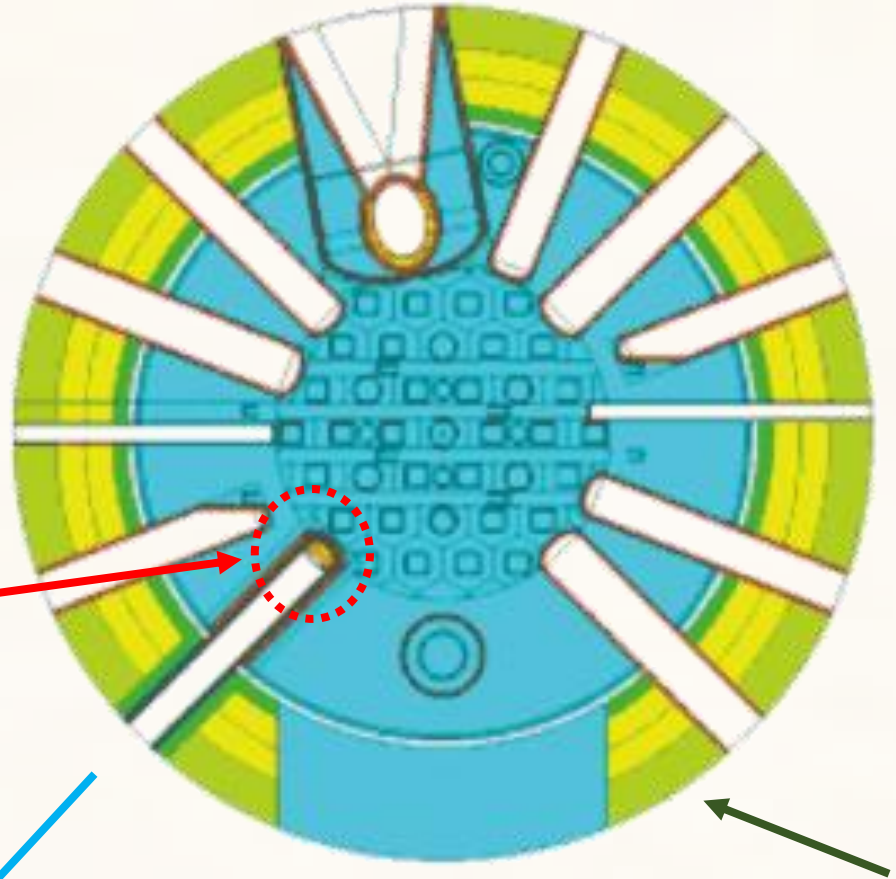
Photo: Wisegeek.org

Overview

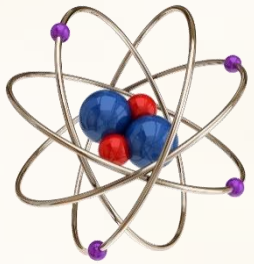
1. What is PeeWee?
2. What is an issue currently needing resolution?
3. What is the solution?



What is PeeWee?



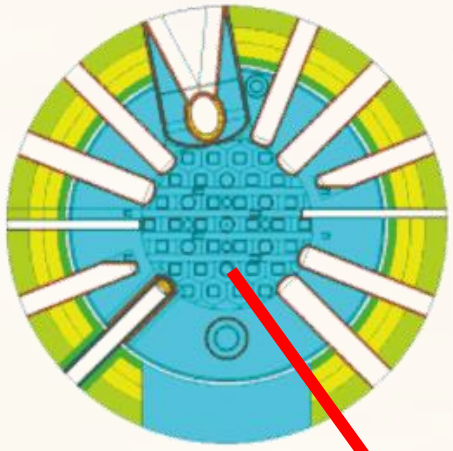
PeeWee = BT-9 Cold Source

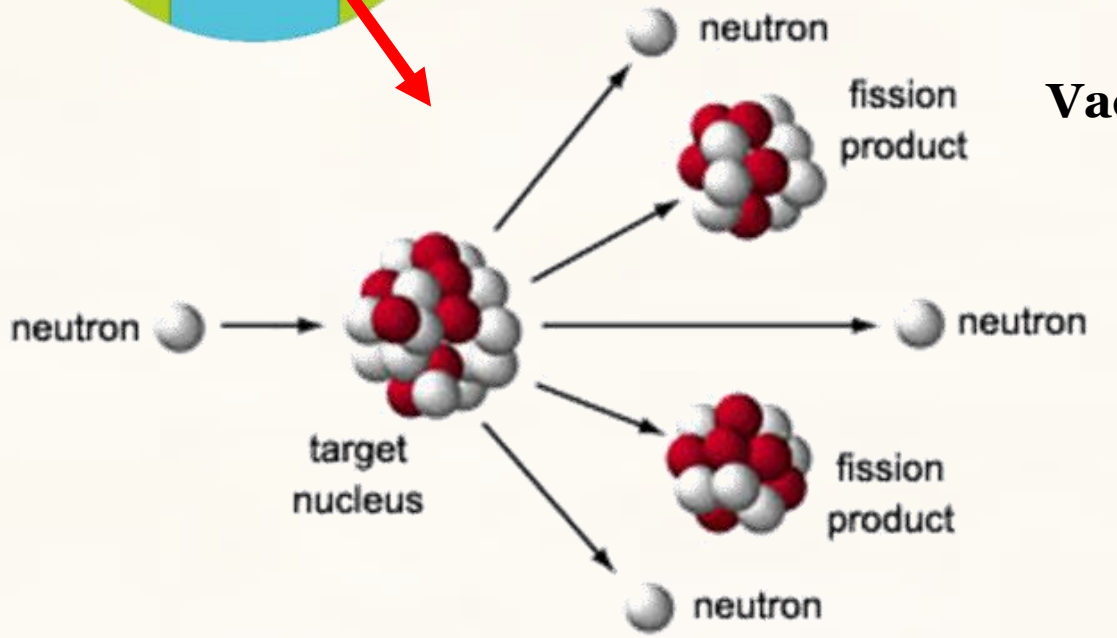


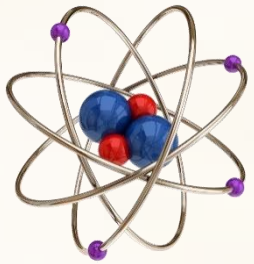
Multi-Axis Crystal Spectrometer (MACS)

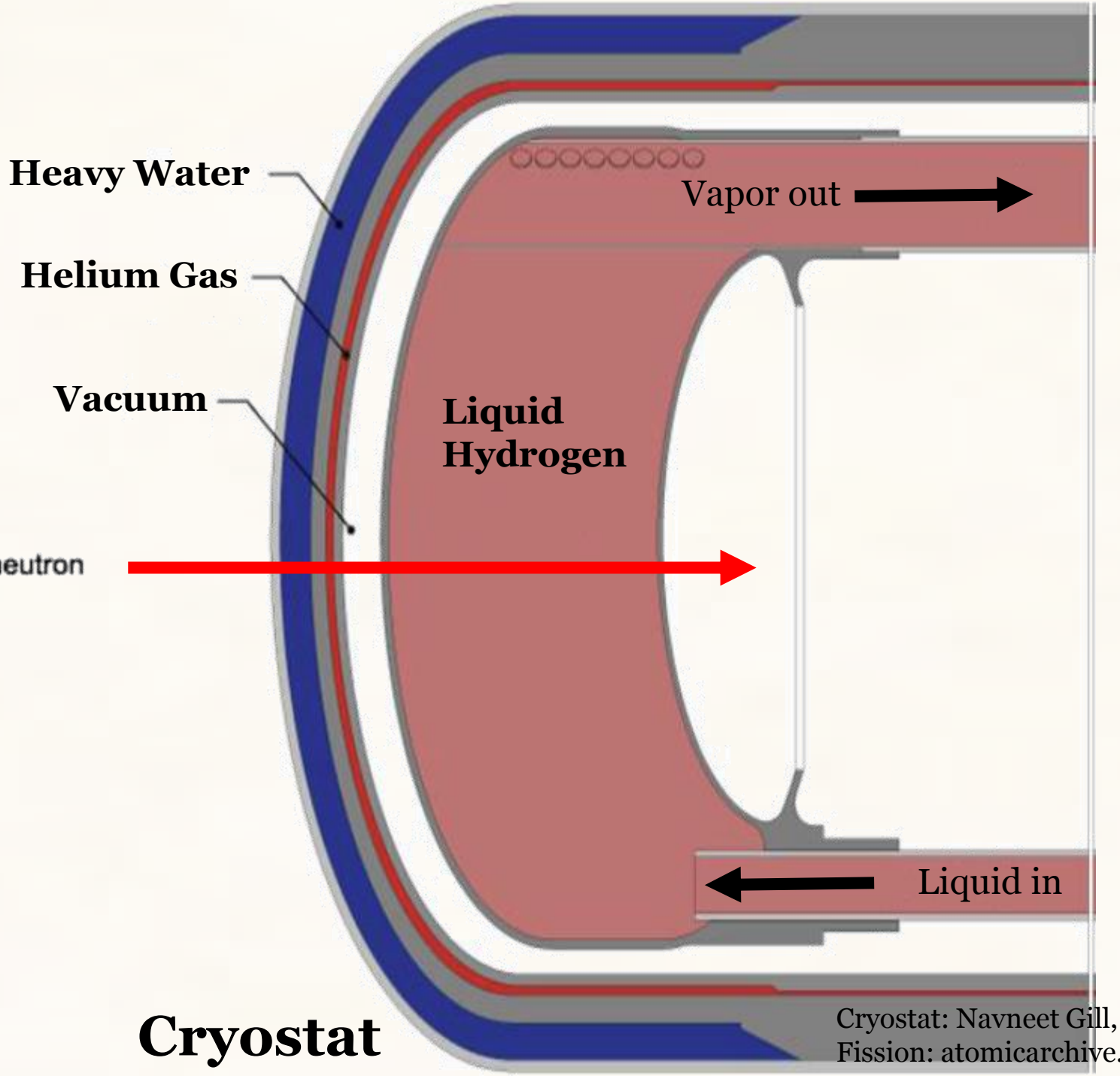
National Bureau of Standards Reactor (NBSR)

Photo: bnl.gov Nuclear Science & Technology Department



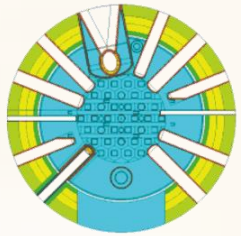






Cryostat

Cryostat: Navneet Gill, 2011
Fission: atomicarchive.com



Thermal Neutrons 2 Å

↓

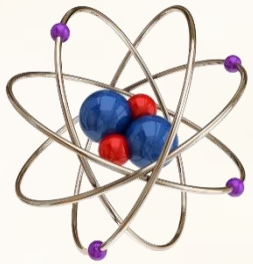
20 K Cold Source

↓

Cold Neutrons 6 Å

2000 Researchers

99% CNS Operation



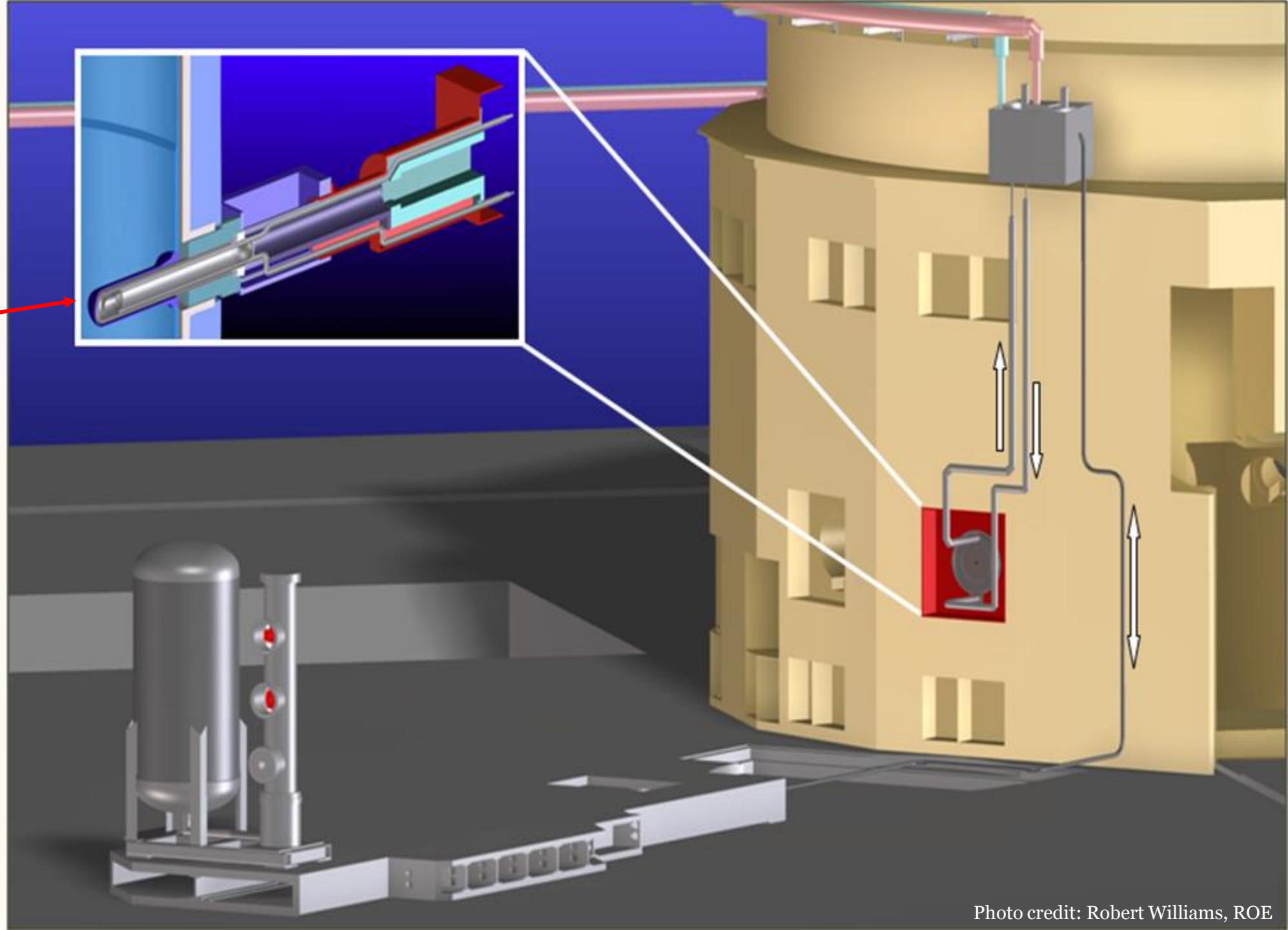


Photo credit: Robert Williams, ROE

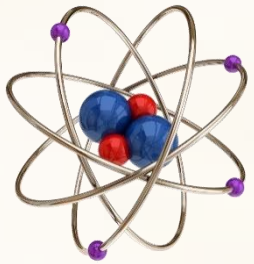
Overview

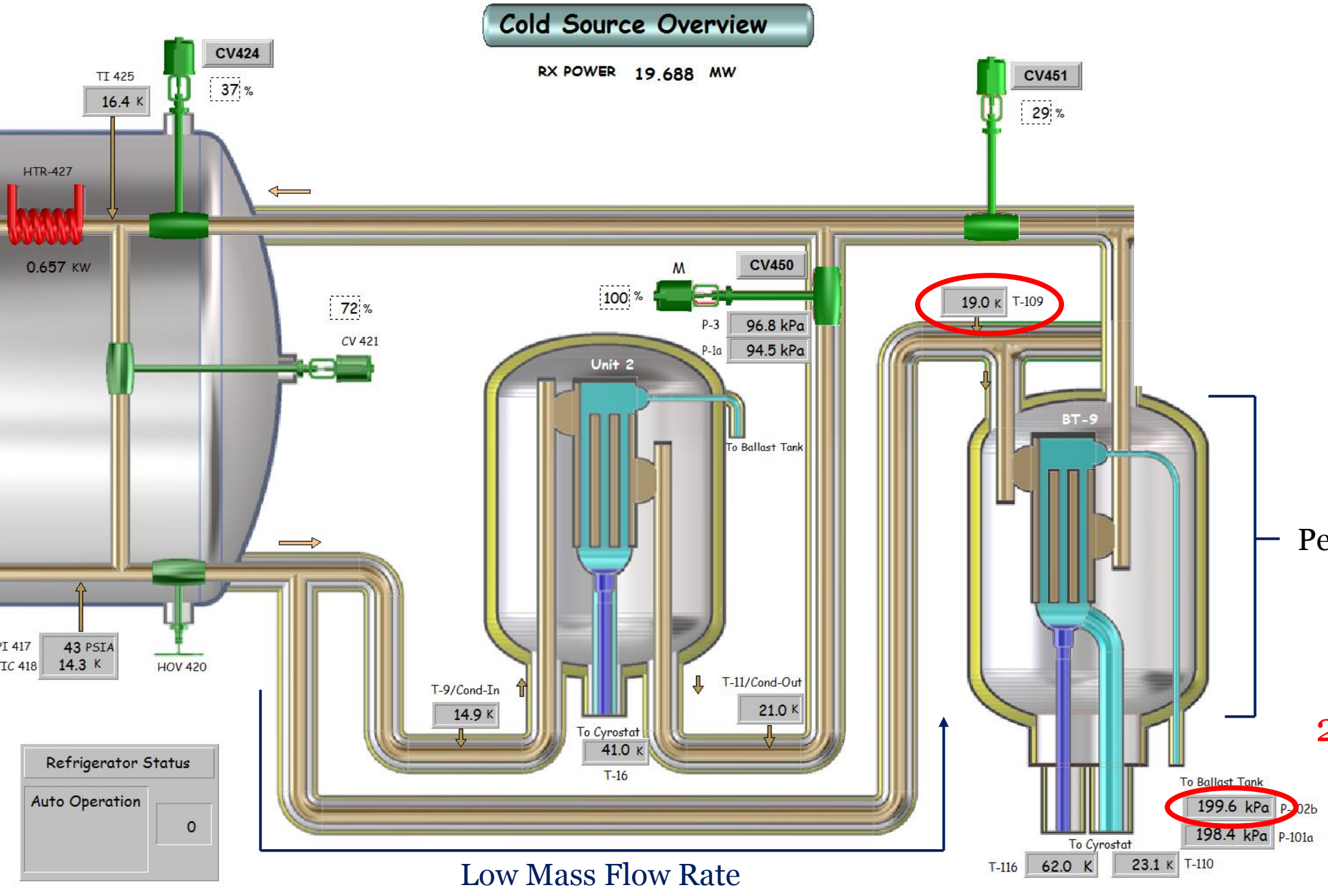
1. What is PeeWee?

2. What is an issue currently needing resolution?

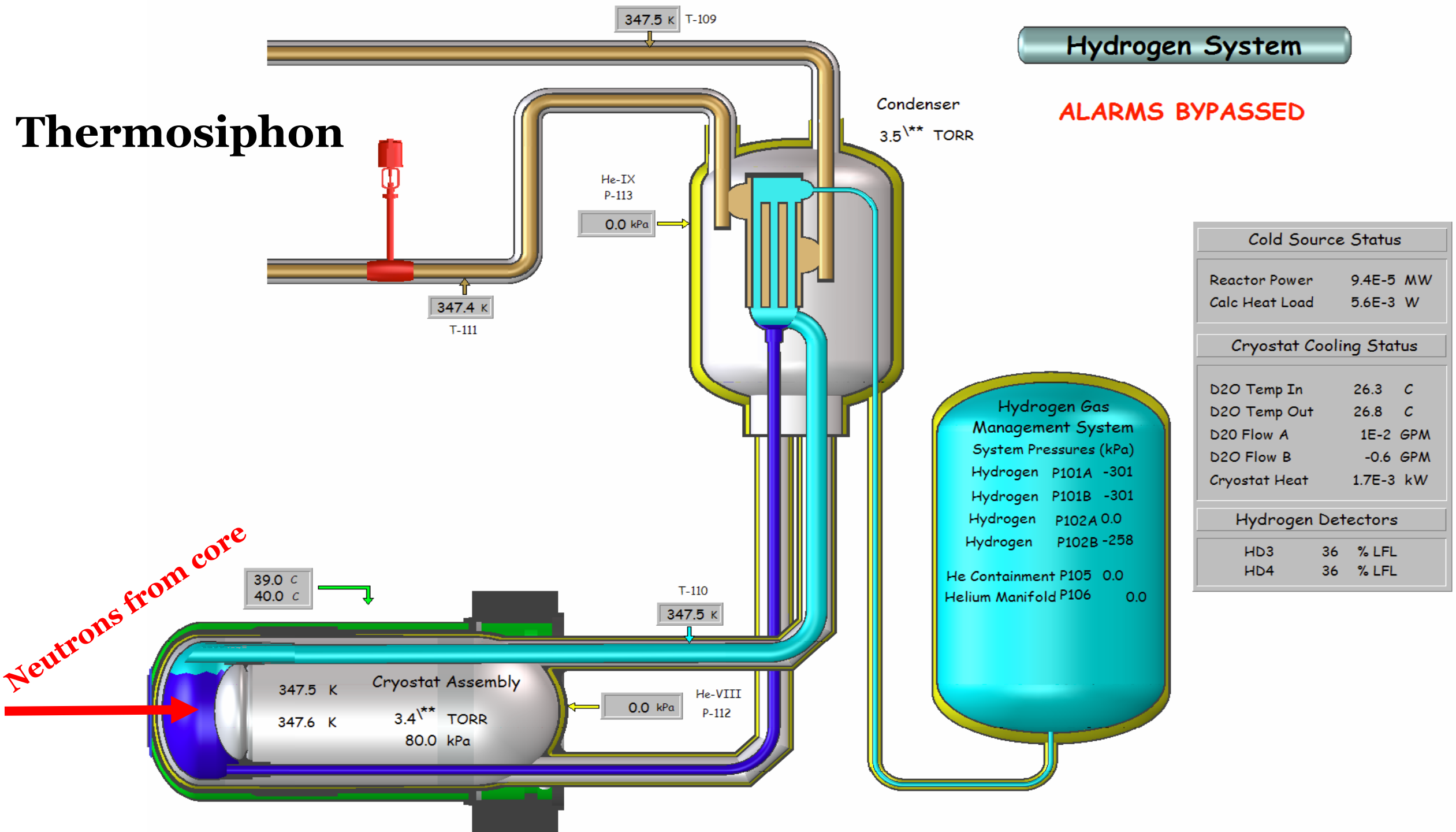
    - **PeeWee condenser helium temperature**

3. What is the solution?




Cold Source Overview
RX POWER 19.688 MW
CV424
37 %
TI 425
16.4 K
HTR-427
0.657 KW
72 %
CV 421
CV450
100 %
M
P-3 96.8 kPa
P-1a 94.5 kPa
Unit 2
To Ballast Tank
CV451
29 %
19.0 K T-109
BT-9
PeeWee Condenser
PI 417
TIC 418
43 PSIA
14.3 K
HOV 420
T-9/Cond-In
14.9 K
T-11/Cond-Out
21.0 K
To Cyrostat
41.0 K
T-16
Refrigerator Status
Auto Operation
0
Low Mass Flow Rate
To Ballast Tank
199.6 kPa
198.4 kPa P-101a
To Cyrostat
T-116 62.0 K
23.1 K T-110
2 atmospheres
b.p. ~ 22.9 K

Thermosiphon



Overview

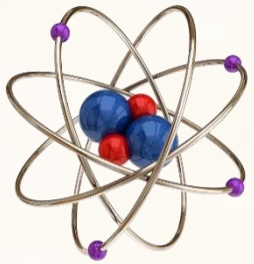
1. What is PeeWee?

2. What is an issue currently needing resolution?

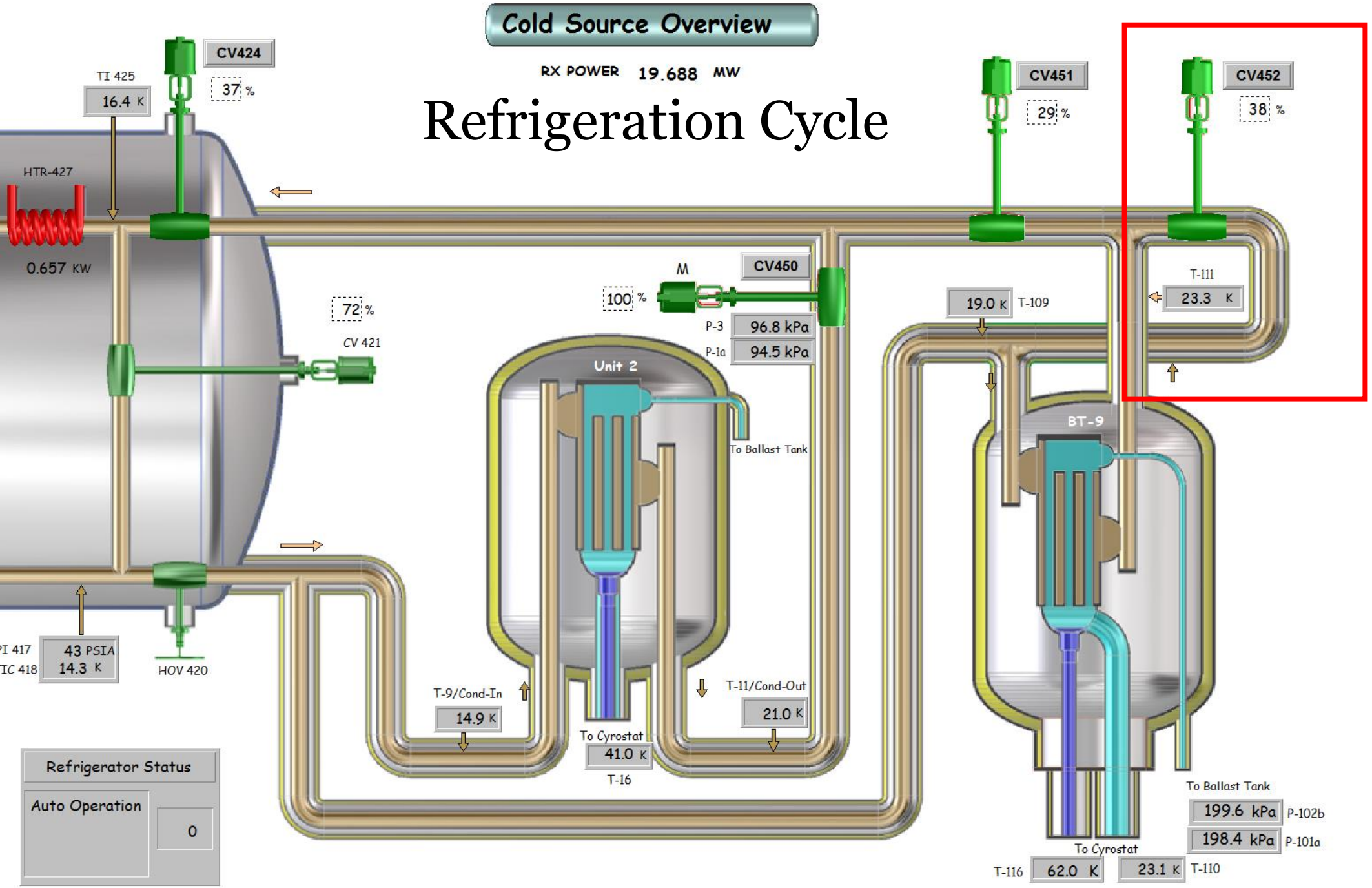
    - **PeeWee condenser helium temperature**

3. What is the solution?

    - **Bypass + Valve**



Refrigeration Cycle

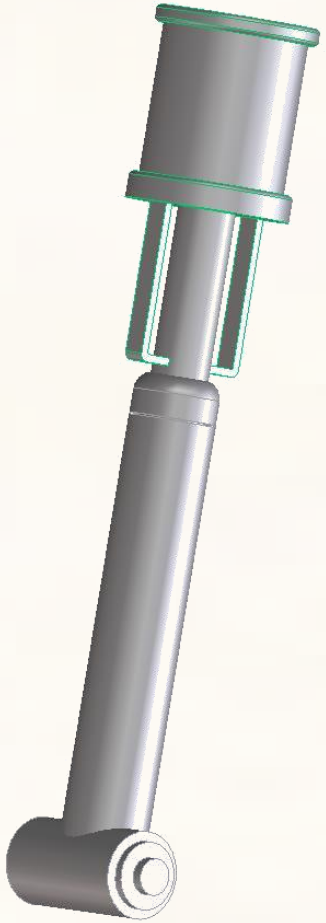


Upgrade

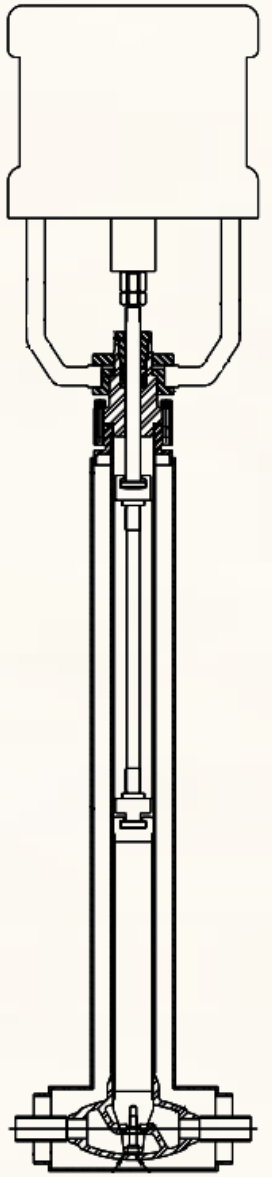
Bypass Valve

CV452

C100 Photo



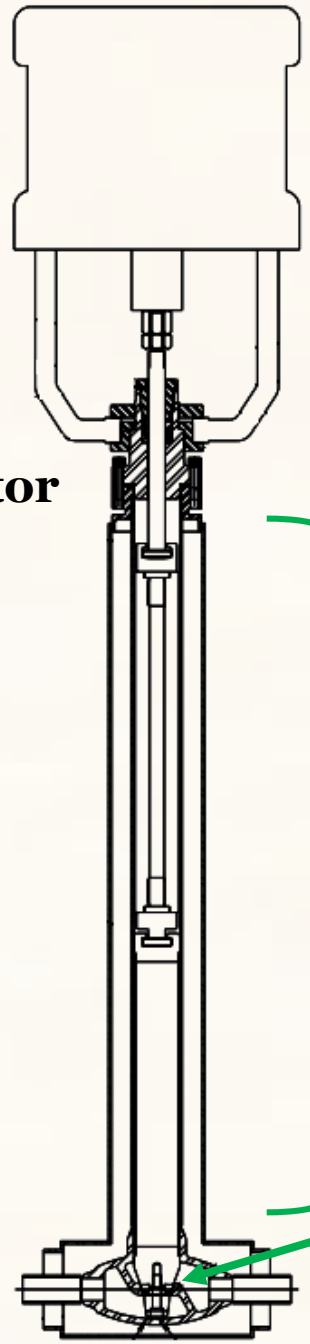
CreoElements 3D Model

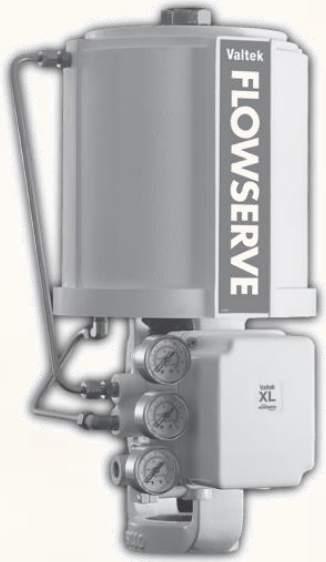


PHPK Manual

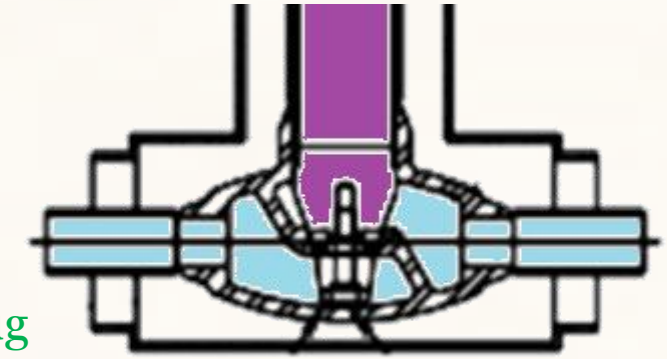
Disclaimer: Use and mention of valve and valve accessories does not imply NIST endorsement

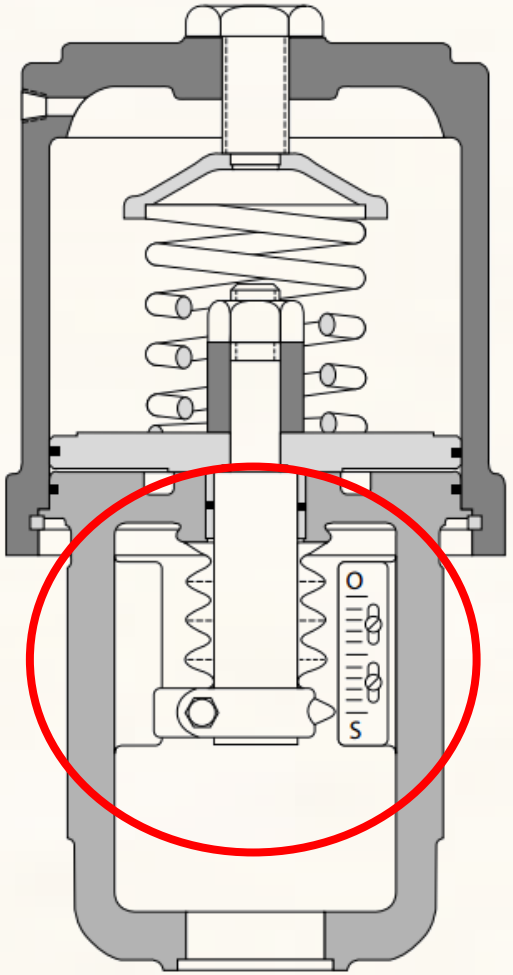
Valtek Actuator
PHPK Valve



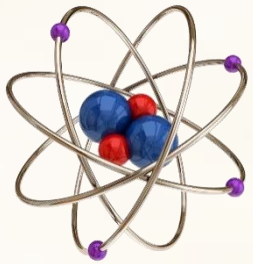


Valtek Flowserve Brochure

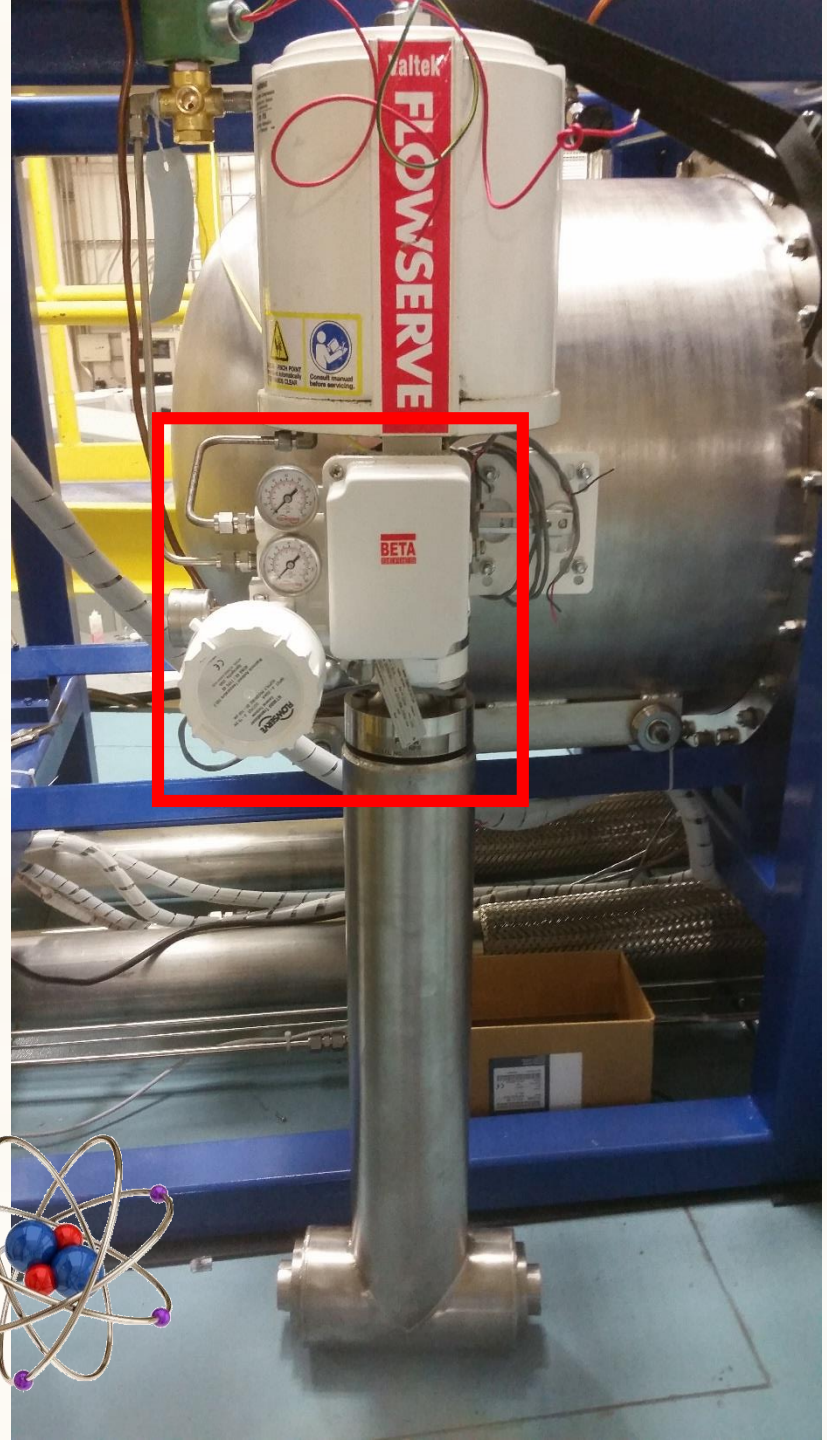




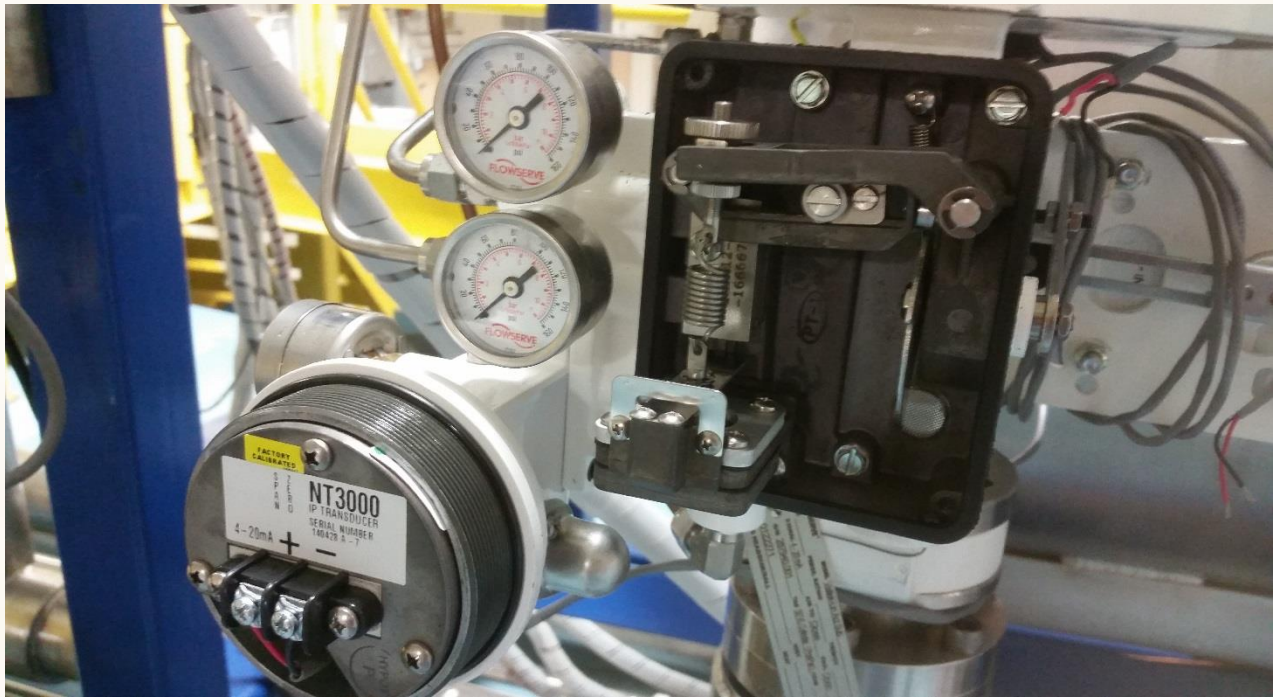
PHPK manual



Positioner

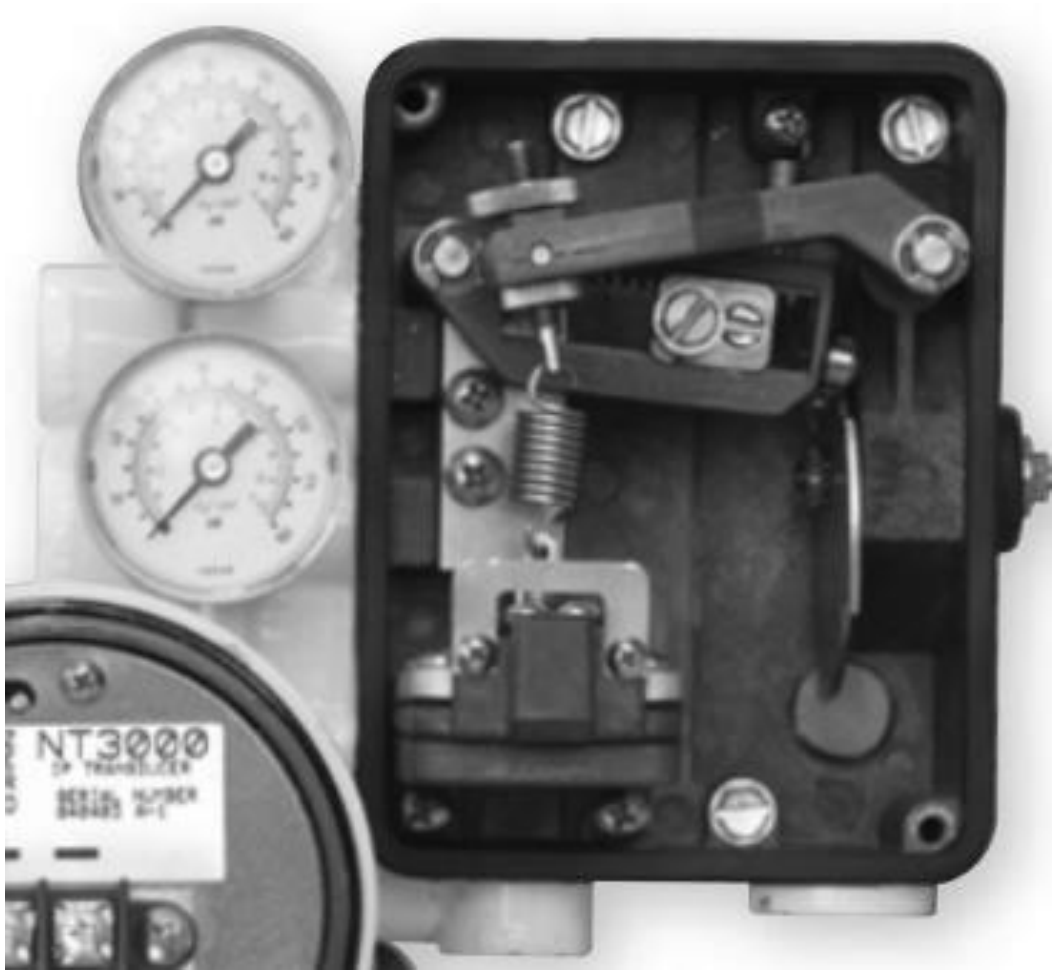


Flowserve
Left: Beta Positioner
Right: NT3000 Electro-Pneumatic Transducer



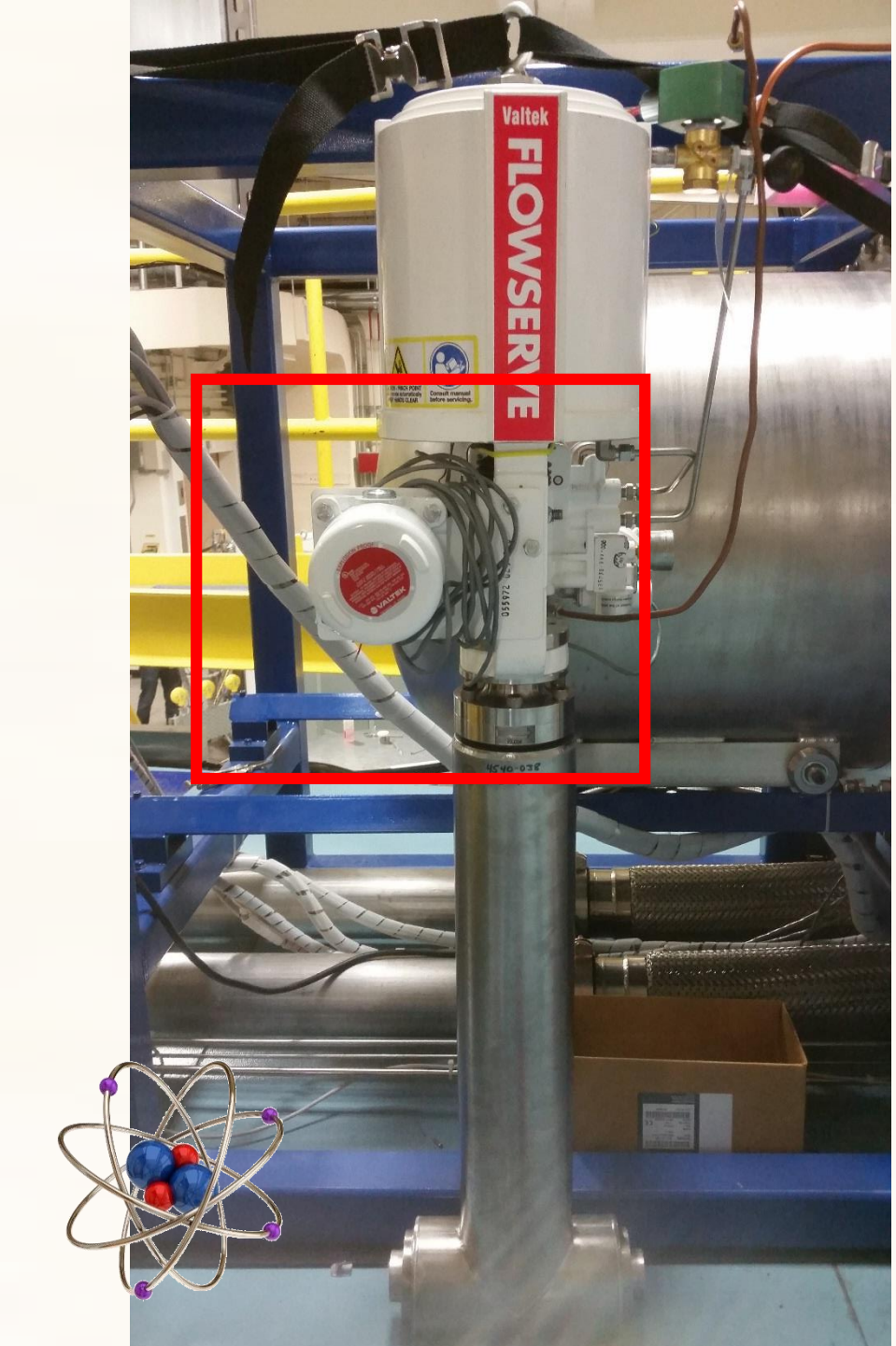
Transducer & Positioner Operation

Transducer



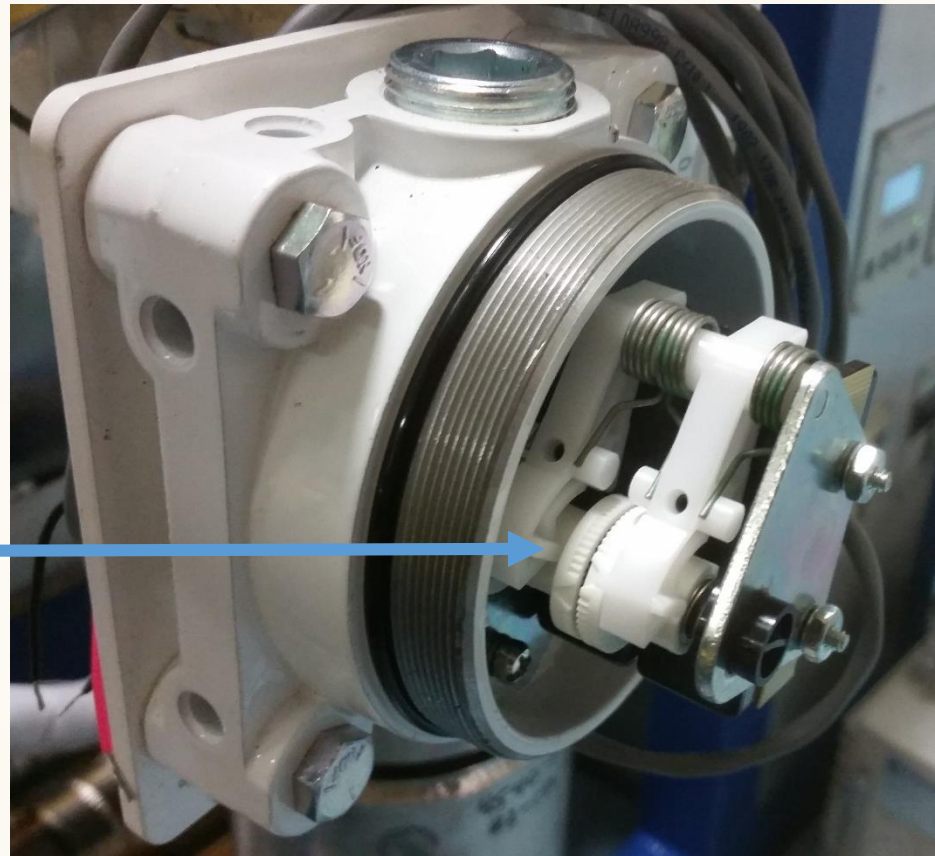
Beta Positioner

Limit Switch



Flowserve
Position Pac

Manual adjustment
of LS cam and lever

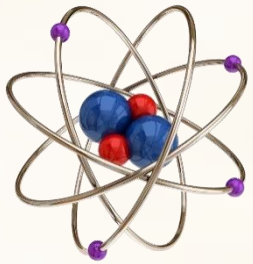


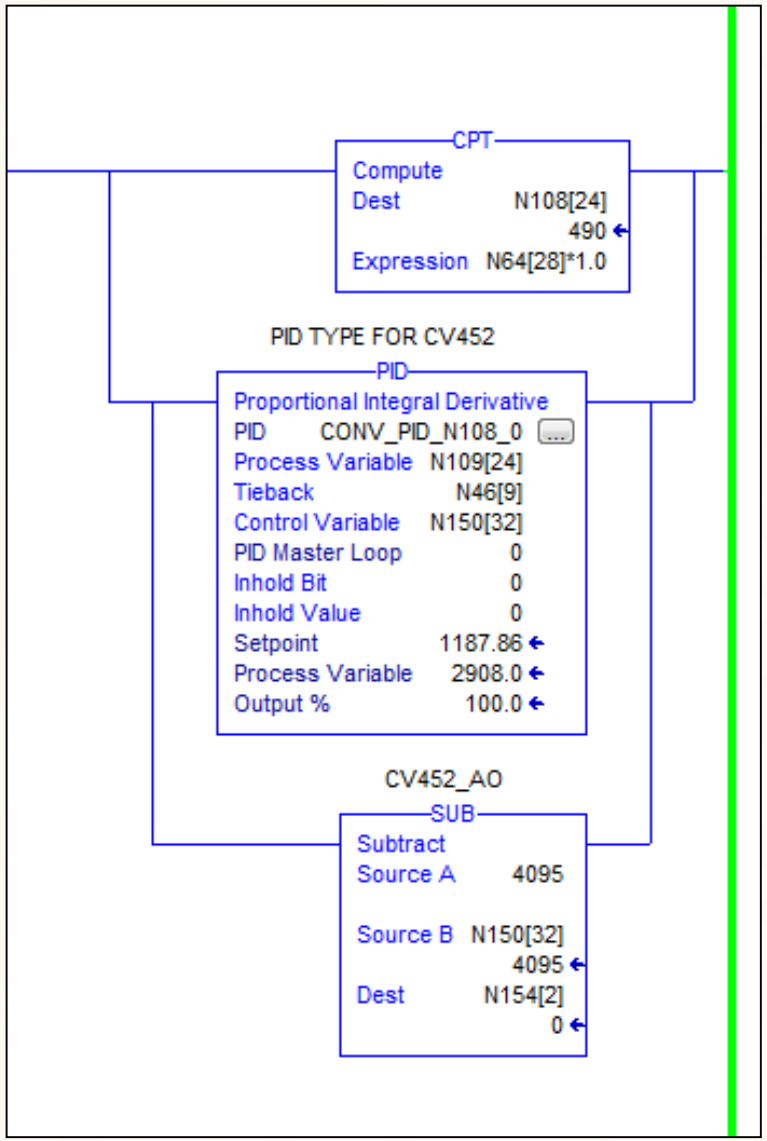
P-Proportional
I-Integral - Controller
D-Derivative

Error = e = SP - PV

$$CV(t) = K_p \cdot \mathbf{e}(t) + K_i \cdot \int_0^t \mathbf{e}(\tau)d\tau + K_d \cdot \frac{d}{dt}(\mathbf{e}(t))$$

Present Past Future



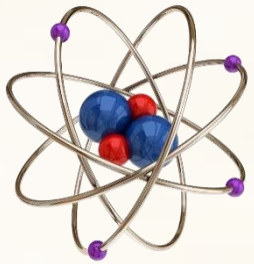


PID controller block used in RS LOGIX 5000

Closing

October 18 – November 11

- Wire Diagrams; creating, updating, and reading
- Soldering
- Pin Connectors
- RS LOGIX 5000 ladder logic programming software
- Creo Elements solid modeling software
- MakerBot 3D printer
- Helium Mass Spectrometry for vacuum testing
- Vacuum Gauge; testing and calibrating vacuum range
- Calibrator for a dummy signal in testing valve position



Thank you,

Michael Middleton

Robert Williams

Mike Rowe

Julie Borchers

Terrell Vanderah

Robert Shull

SURF